

MISSION OPERATIONS DIRECTORATE FLIGHT DIRECTOR OFFICE



STS-110/8A MISSION OPERATIONS

FLIGHT READINESS REVIEW

March 26, 2002

**DA8/R. E. Castle
DA8/J. Hanley**

Agenda

- Mission Summary
- Shuttle Flight Software
- Flight Design & Ascent Overview
- Flight Procedures
- Joint Operations Integrated Procedures
- Crew Training
- Flight Controller Training
- Significant Flight Rules
- Special Topics
- Open Work
- Network
- USA Flight Operations
- Readiness Statements
- * Back-Up Material Included

To Be Presented

No Issues

No Issues*

No Issues

No Issues

No Issues

No Issues

No Issues

SSRMS

Presented with SSRMS Topic

To Be Presented

To Be Presented

Included



MISSION OPERATIONS DIRECTORATE
Flight Director Office
NASA Johnson Space Center, Houston, Texas



Mission Summary



<h1>Shuttle Overview</h1>	Presenter DA8/J. Hanley	
	Date 3/26/02	Page 1

- OV-104 Atlantis
- Crew

CDR Mike Bloomfield	MS 5/EV 1	Steve Smith
PLT Steve Fricke	MS 1/EV 2	Rex Walheim
MS 2 Ellen Ochoa	MS 4/EV 3	Jerry Ross
	MS 3/EV 4	Lee Morin
- Launch Date 4/04/02
- Launch Window

FD3 Open	22:07:47 GMT	17:07:47 EST
FD3 Close	22:17:46 GMT	17:17:46 EST
FD4 Close	22:19:35 GMT	17:19:35 EST
- APM 2276 lbs (w/OMS assist)
- Mission Duration 11+2
- Orbiter Software OI 29
- Landing 4/15/02, 17:02 GMT, 13:02 EDT (10/18:54 MET)
- Lighting Launch-Light, RTLS-Light, TAL-Dark, EOM-Light



Shuttle Overview

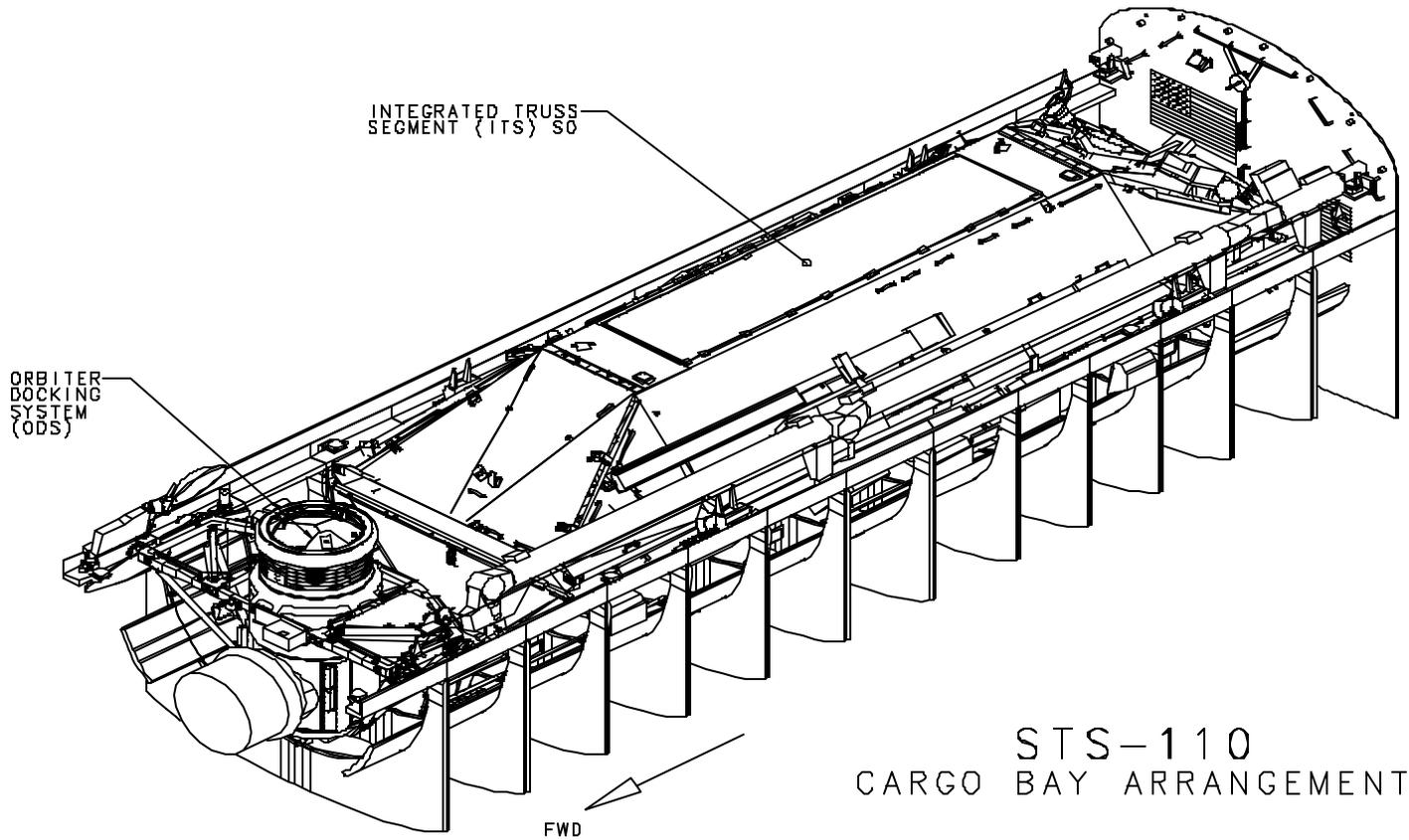
Presenter **DA8/J. Hanley**

Date **3/26/02** Page **2**

- Propulsive Consumables Summary
 - OMS/ARCS (load/margin) Loaded full/490 lbm
 - FRCS Loaded full/40 lbm
 - Protects for rendezvous at 210 n.mi, 2-2-2 deorbit protection, reboost, OMS assist timer = 76 sec, SIMPLEX 10 sec 2 OME burn
- Non-Propulsive Consumables Summary
 - Cryo H2 (# tanks/lbs margin/launch hold) 5 / 68.9 / 191.5
 - Cryo O2 (# tanks/lbs margin/launch hold) 5 / 360 / 351.7
 - N2 (# tanks/lbs margin) 6 / 71.7
- LiOH
 - 31 cans on shuttle plus 8 cans from ISS stockpile (covers EOM +3)
 - Total of 25 cans available on ISS



<h1>Cargo Bay Layout</h1>	Presenter DA8/J. Hanley
	Date 3/26/02 Page 3



STS-110
CARGO BAY ARRANGEMENT



Mission Priorities

Presenter **DA8/J. Hanley**

Date **3/26/02** Page **4**

- Priorities captured consistent with STS-110 FRD:
 1. Tasks required for survival of 8A delivered hardware
 2. Tasks to prepare for MBS delivery on UF-2.
 3. DTO 700-14 Single String GPS (w/PGSC)
 4. SIMPLEX
 5. RAMBO (no OMS burn)
 6. Remaining DTO's (263 – reboost tuning, 264 – SSRMS dynamic loads validation)
 7. DSO's



Flight Overview

Presenter **DA8/J. Hanley**

Date **3/26/02** Page **5**

- FD 1 Launch
- FD 2 RMS and EMU checkout
- FD 3 ISS rendezvous, dock, PLB survey w/SSRMS
- FD 4-9 S0 install, EVA's 1-4, MT checkout, transfers
- FD 10 Undock/Flyaround
- FD 11 SIMPLEX, FCS checkout, cabin stow
- FD 12 Landing



Flight Overview

Presenter **DA8/J. Hanley**

Date **3/26/02** Page **6**

FD1 April 4th launch (~17:13 EST) – crew to bed shortly after post-insertion

FD2 is typical – check suits, shuttle arm, set up flight deck for rendezvous

FD3 rendezvous and docking has become as routine as such things get

–Once hatches open we do some early transfers and set up Robotics workstations in “Destiny” in prep for S0 install the next day.

–This will include Ellen and Dan flying the arm around with the comm. and video they way they want it...



Flight Overview

Presenter **DA8/J. Hanley**

Date **3/26/02** Page **7**

FD4 EVA1 looms as our most challenging day...

–Ellen and Dan will begin shortly after wakeup with grapple and unberthing of the S0 while EV crew begins their preparations in “Quest”

–EV crew egresses “Quest” just as SSRMS becomes available for EVA support

- Install two forward strut “bipods”
- Deploy aft umbilical tray
- Deploy port and starboard umbilical strays on “Destiny”
- Deploy Zenith TUS

–When EVA1 complete, S0 is structurally and thermally safe

FD5 a rest/regroup day, setup Oxygen transfer from shuttle to station tanks, some transfers



Flight Overview

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FD6 EVA2 complete's the mechanical installation of S0

- Install two aft strut "tripods"
- Remove keels so MT can translate
- Deploy Nadir TUS

FD7 EVA3 focuses on rewiring SSRMS interfaces through the S0

- Powerdown half of S0 at a time
 - SSRMS power, data, and video rerouted
 - Use shuttle arm for work platform
- Release MT launch locks and restraints, prep for first motion
- If all goes well, SSRMS recovered in time to support airlock spur

FD8 MT Checkout – perform 3 translations, leaving MT in position for UF-2

- Also provide some much needed off-duty time



Flight Overview

Presenter **DA8/J. Hanley**

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FD9 EVA4 is various outfitting tasks

–small jobs to set up work platforms, complete outfitting
MT, install worklights, etc.

FD10 final goodbyes followed by undock and flyaround

FD11 Cabin stow and entry preps

FD12 Landing (~13:50 EDT April 15)



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Flight Director Office
 NASA Johnson Space Center, Houston, Texas



<h1 style="margin: 0;">Flight Overview</h1>	Presenter DA8/J. Hanley
	Date 3/26/02
	Page 10

0:00	1:00	2:00	3:00	4:00	5:00	6:00
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EVA 1 (6:25)

*	Egress / Setup (0:45)	Install Fwd MTS Struts	Deploy Aft Lab Tray	Assist EV2	Deploy Aft Lab Tray	Install CID 7	Asst EV2	Install CID 8	Install TUS 1 Zenith Cable (0:30)	Cleanup / Ingress (0:30)	\$	
*	Egress / Setup (0:45)	Install Fwd MTS Struts (2:00)	Install Lab Fwd Stbd Avionics Umbilicals (1:30)		Install Lab Fwd Port Avionics Umbilicals (1:00)	Install TUS 1 Zenith Cable (0:30)	Cleanup / Ingress (0:30)	\$				
SSRMS Port								2B String Up		4B String Up		

EVA 2 (6:30)

*	Egress / Setup (0:30)	Install Stbd Aft MTS Strut	Install Port Aft MTS Strut	Remove / Stow Drag Links	Install TUS 2 Nadir Cable (0:30)	Remove / Stow Keel Pins	Cleanup / Ingress (0:30)	\$
*	Egress / Setup (0:30)	Install Stbd Aft MTS Strut (2:00)	Install Port Aft MTS Strut (1:30)	Remove / Stow Drag Links (0:20)	Install TUS 2 Nadir Cable (0:30)	Remove / Stow Keel Pins (1:00)	Cleanup / Ingress (0:30)	\$
SSRMS Stbd				SSRMS Port			SSRMS Stbd	

EVA 3 (6:30)

*	Egress / Setup (0:45)	LCA Claw	OPT: CID 8 (cont ...) or Get-Ahead	Asst EV3	Release MT Launch Restraints (0:45)	Asst EV3	OPT: CID 7 (cont ...) or Get-Ahead	Asst EV3	Shuttle Tool Transfer (0:50)	Install Airlock Spur (0:30)	Cleanup / Ingress (0:45)	\$
*	Egress / Setup (0:45)	Install J300 PDGF Connectors (1:00)	Reconfigure J400 PDGF Connectors - Primary (0:15)	Release MT Launch Restraints (0:45)	Reconfigure J400 Panel PDGF Connectors - Redundant/Data (1:30)	Shuttle Tool Transfer (0:50)	Install Airlock Spur (0:30)	Cleanup / Ingress (0:45)	\$			
SSRMS Stowed / SRMS Prime for EVA										SSRMS Stbd		

EVA 4 (6:30)

*	Egress / Setup (0:30)	Release LCA Guide Cones	Assemble PWP	Deploy EV-CPDS	Deploy Node 1 Swing Arm - H/W Only	Remove Z1 MLI	Photo Closeout	Cleanup / Ingress (0:45)	\$
*	Egress / Setup (0:30)	Install Node EVA Light (0:45)	Assemble PWP (0:30)	Install Lab EVA Light (0:45)	Install MT Energy Absorbers (1:00)	Install S0 handrails (0:45)	Photo Closeout (1:20)	Cleanup / Ingress (0:45)	\$
SSRMS Stbd		SSRMS Port				SSRMS Stbd			

TOP – Free Float EVA Crew
 BOTTOM – SSRMS/SRMS EVA Crew
 * Post Depress (0:05)
 \$ Pre Reprass (0:05)

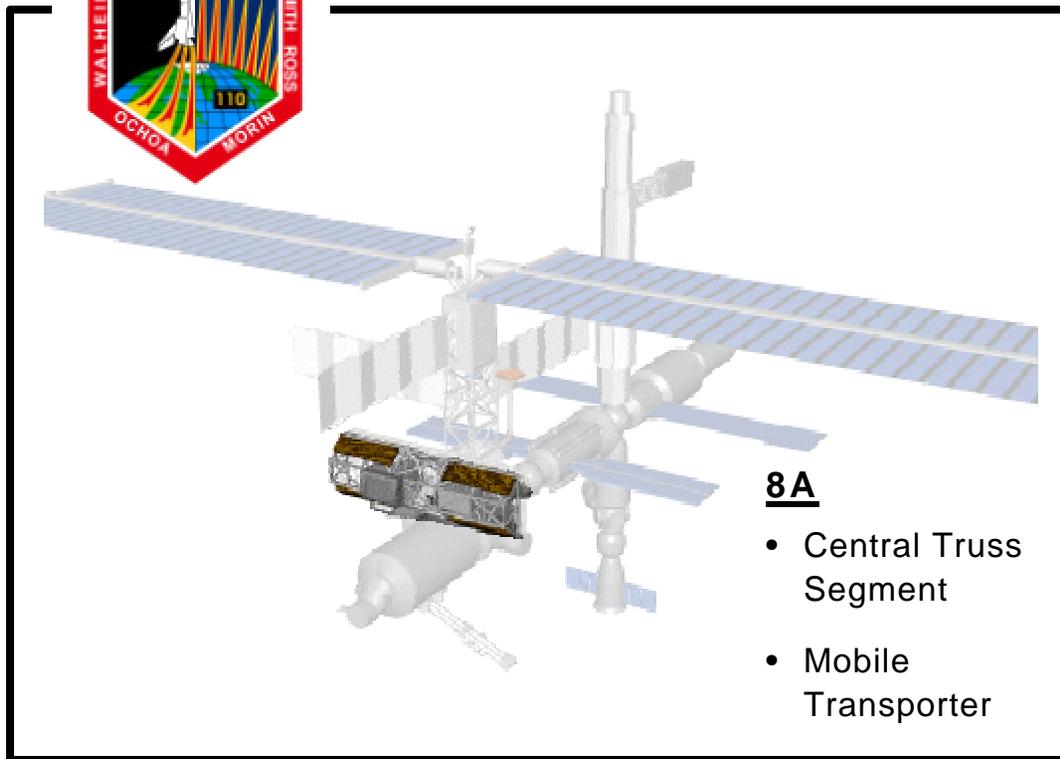
Special Topics

SSRMS Wrist Roll Anomaly – Part of Special Topic Presentation.



STS-110/ISS 8A Flight Readiness Review

Networks



8A

- Central Truss Segment
- Mobile Transporter

Agenda

- Other SN Supported Launches
- Significant Changes & Test Activities

Ted Sobchak
Network Director
GSFC/Code 450
March 26, 2002



STS-110/ISS 8A Mission and Data Services



Other SN Supported Launches

- **SN Launch and Early Orbit (LEO) requirements for the AQUA spacecraft and Delta II could effect Shuttle scheduling if STS-110 launch slips or landing is delayed**
 - **Delta II/AQUA launch is planned for April 18**
 - **Nominal Atlantis landing is April 15 with possible 2 days extension**
 - **May require the use of virtual spacecraft support for ISS/Space Shuttle in the event of conflicts**



STS-110/ISS 8A Mission and Data Services



Significant Changes

- **A.F. Remote Tracking Sites (RTS)**
 - Oakhangar (England) UHF requirement deleted effective with STS-110 mission - supported backup to TDRS during high inclination ascent
- **NISN RSA Interface**
 - A back-up hub to the existing Mission Hub has been installed at the MCC-M
 - Provides same level of redundancy that exists on the mission node at MCC-H
- **GSFC Flight Dynamics Facility (FDF)**
 - FDF has been using tracking data provided by the ISS to TDRSS link to automatically provide an ISS orbit determination.
 - This solution has been used since February 11 to provide acquisition data for TDRS support to ISS during undocked operations.



STS-110/ISS 8A Mission and Data Services



Significant Test Activities

- **Modular Memory Unit (MMU)**
 - Atlantis is the first Orbiter outfitted with a new unit that provides a solid state recorder (SRR) for Shuttle operational data
 - Unit will provide more efficient use of TDRS time for data playbacks
 - Network testing completed. On-orbit evaluation activities planned.
- **Digital Television (DTV)**
 - Atlantis will be carrying new DTV equipment developed at JSC for STS and ISS. Testing verified 48 Mbps data via TDRS to MCC.



Space Communications and Data Systems



Certificate of Readiness

Pending completion of flight readiness preparations, remaining standard work and closure of all action items, NASA dedicated elements and all CSOC resources are ready to support the STS-110 - 13th ISS Flight (8A)/Central Truss Segment (ITS SO) and Mobile Transporter (MT)

P. E. Liebrecht

3/14/02

P. E. Liebrecht **Date**
Associate Director, Program Manager for Mission Services
Goddard Space Flight Center

G. Morse

3/12/02

G. Morse **Date**
Manager, Space Operations Services
Johnson Space Center

D. Tighe

3/18/02

D. Tighe **Date**
CSOC Program Manager

Presenter:

S. Hartwig

Organization/Date:

Flt Ops 3/26/02

STS-110 / 8A
Flight Readiness Review
3/26/02
USA Flight Operations

AGENDA

Presenter:

S. Hartwig

Organization/Date:

Flt Ops 3/26/02

- Facilities Readiness
- Flight Design, Product and Training Readiness
- Out of Family - None
- Special Topics - None
- CoFR Statement

FACILITIES READINESS

Presenter:

S. Hartwig

Organization/Date:

Flt Ops 3/26/02

- Mission Control Center (MCC)
 - Software changes
 - MCC platform system software release – Ganymede 2.0
 - New Capabilities
 - Improved command acknowledgment protocol between MSFC POIC & MCC
 - Improved file transfer capability for MSFC POIC
 - Started use in Shuttle and Station generic simulations – 1/2/02
 - Started use in flight specific simulations (STS-110/111) – 1/09/02
 - Over 2980 hours of testing completed

FACILITIES READINESS

Presenter:

S. Hartwig

Organization/Date:

Flt Ops 3/26/02

- Mission Control Center (MCC)
 - Trajectory System Upgrade (TSU)
 - First flight of TSU as prime capability for trajectory processing during orbit and entry phases
 - Project re-hosted MOC trajectory functionality from IBM mainframe to UNIX servers and workstations on the MCC distributed network
 - TSU will still do flight following for ascent - mirroring activities of the Flight Control team to demonstrate workstation based trajectory capabilities for ascent in preparation for STS-111

FACILITIES READINESS

Presenter:

S. Hartwig

Organization/Date:

Flt Ops 3/26/02

- Mission Control Center (MCC)
 - Trajectory System Upgrade – cont'd
 - Shelf life
 - Flight following completed in Ops environment
 - STS-108, all flight phases, uncertified mode
 - STS-109, all flight phases, certified mode
 - Over 1000 hours of user testing / evaluation received in Ops mode
 - Training and simulations / no impacts
 - 57 Generic sims supported
 - 9 Flight specific (STS-110) sims supported
 - Server failure fallback plan in place
 - Switchover back to MOC transition occur within 1 hour

FACILITIES READINESS

Presenter:

S. Hartwig

Organization/Date:

Flt Ops 3/26/02

- Flight Design & Dynamics
 - Just-In-Time-Flight Design process improvement incorporates changes in the I-Load uplink
 - Continuation of effort started with OI-26, OI-28
 - Improves flexibility for responding to L-30 TDDP mass property changes
 - Allows changes to OMS Assist, Abort Dump Timers, Masses, and Velocities Load
 - Will reassess/redesign for each flight during the Uplink Cycle inside L-30
 - PRCB approved 12/14/00
 - All required testing, validation, and verification complete

STS-110/8A
Certification of Flight Readiness

Presenter:

S. Hartwig

Organization/Date:

Flt Ops 3/26/02

- The USA Flight Operations FRR, NASA MOD FRR, and USA SFOC Pre-FRR have been completed
- All Contractor Accountable Functions (CAF) have been completed, or are scheduled for completion, in accordance with NASA requirements and the applicable portions of the Space Flight Operations contract Flight Preparation Process Plan (NSTS 08117, section 8.5.18 and appendix “R”).
- All required products have been or are scheduled to be delivered per requirements.
- All facilities have been configured and are ready for mission support.
- All CAF personnel are trained and certified or will be trained and certified prior to flight.
- The Flight Crew has been trained.
- There are no open issues.
- Pending completion of the defined open work:

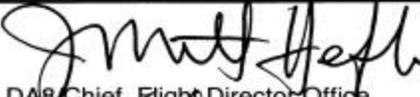
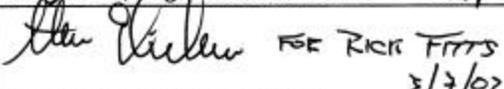
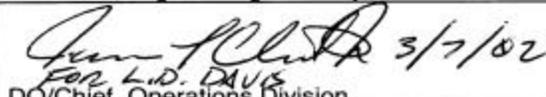
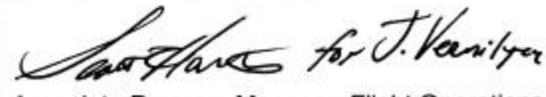
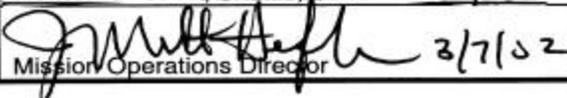
**USA FLIGHT OPERATIONS IS READY
TO SUPPORT THE STS 110/8A MISSION**



C. Knarr
Associate Program Manager, Flight Operations

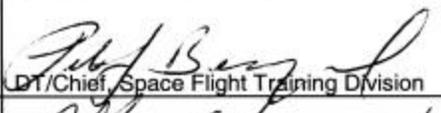
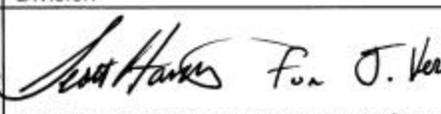
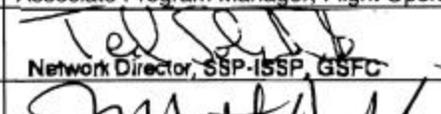
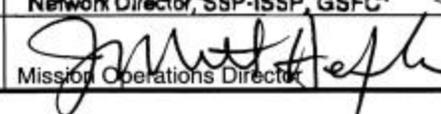


MISSION OPERATIONS DIRECTORATE
SHUTTLE CERTIFICATE OF FLIGHT READINESS (CoFR)
FLIGHT: STS-110/8A REQUIREMENTS

Critical Processors/Applications, Non-Crit Processors/Applications; Flight Rules: EMCC; Trng-MCC /POCC; FTP-New Operations; Anomaly-Proc; Ex/AI from Prior Reviews; CIL/Hazards; No Constraints; Level II Actions; Mission Requirements; Exception Resolution; CMD Proc; FPPP Requirements Met; Contractor Process Insight	 DAB/Chief, Flight Director Office 3/7/02
Crit Processors/Applications; Non-Crit Processors/Applications; FDF; EMCC; TRNG-MCC/POCC; LCC; FTP-New Ops; Flight Anomaly Resolution; Anomaly-Proc; Ex/AI from Prior Reviews; CIL/Hazards; No Constraints; Level II Actions; Mission Requirements; Engineering Drawings; CMD Proc; FPPP Requirements Met; Contractor Process Insight	 DF/Chief, Systems Division 3/7/02
Crit Processors/Applications; Non-Crit Processors/Applications; FDF; EMCC; RECON-Flight S/W (MMU); TRNG-MCC/POCC; FTP-New Ops; Flight Anomaly Resolution; Anomaly-Proc; Ex/AI from Prior Reviews; No Constraints; Level II Actions; Mission Requirements; CMD Proc; FPPP Requirements Met; Contractor Process Insight	R.C. Epps 3/7/02 DM/Chief, Flight Design and Dynamics Division
Crit Processors/Applications; Non-Crit Processors/Applications; FDF; FDF Manage; EMCC; PGSC; TRNG-MCC/POCC; FTP-New Ops; Flight Anomaly Resolution; Anomaly-Proc; Ex/AI from Prior Reviews; CIL/Hazards; No Constraints; Level II Actions; Mission Requirements; Engineering Drawings; CMD Proc; FPPP Requirements Met; Contractor Process Insight	 DO/Chief, Operations Division 3/7/02
EX/AI from Prior Reviews; No Constraints; Level II Actions; Mission Requirements; FPPP Requirements Met; Contractor Process Insight	 DT/Chief, Space Flight Training Division 3/7/02
FPPP Requirements Met; Contractor Process Insight	 DV/Chief, Advanced Operations & Development Division 3/7/02
FAC-NBL; FAC-SVMF; FDF; TRNG-Crew Trng; TRNG-MCC/POCC; TRNG-EVA/MARS; LCC; FTP-New Ops; Flight Anomaly Resolution; Anomaly-Proc; Ex/AI from Prior Reviews; CIL/Hazards; No Constraints; Level II Actions; Mission Requirements; Engineering Drawings; CMD Proc; EVA Hardware Integration; Contractor Process Insight	Ronald B. ... 3/7/02 DX/Chief, EVA, Robotics, & Crew Systems Operations Division
FAC-MCC; FAC-Network Interface; FAC-SMS; FAC-SPF; FAC-IPS; Crit Processors/Applications; Non-Crit Processors/Applications; FD-Trajectory; FD-Consumables; FD-PDRS; FD-Analyst Cert; FD-CTF; FDF Manage; EMCC; RECON-STAR/MASTII/CD ROM Products; RECON-MCC; TRNG - Crew Trng; TRNG-MCC/POCC; TRNG-SMS; FTP-New Ops; Flight Anomaly Res; Anomaly-Proc; Ex/AI from Prior Reviews; CIL/Hazards; No Constraints; Level II Actions; Mission Requirements; Engineering Drawings; Exception Resolution; CMD Proc; FPPP Requirements Met	 Associate Program Manager, Flight Operations, SFOC
EMCC; NETWORK; Flight Anomaly Resolution; Anomaly-Proc; Ex/AI from Prior Reviews; No Constraints; Level II Actions; FPPP Requirements Met	T. S. ... 3/7/02 Network Director, Shuttle, GSFC
	 Mission Operations Director 3/7/02

MISSION OPERATIONS DIRECTORATE
ISS CERTIFICATE OF FLIGHT READINESS (CoFR)
STS-110/8A REQUIREMENTS

ISS REQUIREMENTS

Critical Processors/Applications; Non-Crit Processors/Applications; Flight Rules; EMCC; Trng-MCC/POIC/POCC; JOP-New Operations; Anomaly-Proc; Ex/AI from Prior Reviews; CIL/Hazards; No Constraints; Program Actions; Mission Requirements; Exception Resolution; CMD Proc; Contractor Process Insight	 DA8/Chief, Flight Director Office 3/7/02
Crit Processors/Applications; Non-Crit Processors/Applications; ODF/SODF; EMCC; TRNG-MCC/POIC/POCC; LCC; JOP-New Ops; Flight Anomaly Resolution; Anomaly-Proc; Ex/AI from Prior Reviews; CIL/Hazards; No Constraints; Program Actions; Mission Requirements; CMD Proc; EVA Hdwr; Contractor Process Insight	Ladessa Hicks for 3/7/02 DF/Chief, Systems Division
EX/AI from Prior Reviews; No Constraints; Program Actions; Mission Requirements; Contractor Process Insight	D.R. Davide 3/7/02 DL/Chief, Flight Avionics Division
Crit Processors/Applications; Non-Crit Processors/Applications; TRNG-MCC/POIC/POCC; JOP-New Ops; Flight Anomaly Resolution; Anomaly-Proc; Ex/AI from Prior Reviews; No Constraints; Program Actions; Mission Requirements; CMD Proc; FD-Flight Mechanics, FD-Analyst Cert. FD-CTF	R.E. Egan 3/7/02 DM/Chief, Flight Design and Dynamics Division
Crit Processors/Applications; Non-Crit Processors/Applications; ODF/SODF; ODF/SODF Manage; EMCC; TRNG-MCC/POIC/POCC; JOP-New Ops; Flight Anomaly Resolution; Anomaly-Proc; Ex/AI from Prior Reviews; CIL/Hazards; No Constraints; Program Actions; Mission Requirements; CMD Proc; Contractor Process Insight	Signature 3/7/02 Ladessa Hicks for 3/7/02 DO/Chief, Operations Division for C.O. Davis
EX/AI from Prior Reviews; No Constraints; Program Actions; Mission Requirements; Contractor Process Insight	 DT/Chief, Space Flight Training Division 3/8/02
The SSTF maintains a training load consistent with the last training environment for the increments in progress which can, on demand be loaded and updated to the required onboard configuration for any necessary procedure development; contractor process insight.	 PDV/Chief, Advanced Operations & Development Division 3/7/02
FAC-NBL; FAC-SVMF; FDF; TRNG-Crew Trng; TRNG-MCC/POCC; TRNG-EVA/MARS; LCC; FTP-New Ops; Flight Anomaly Resolution; Anomaly-Proc; Ex/AI from Prior Reviews; CIL/Hazards; No Constraints; Level II Actions; Mission Requirements; Engineering Drawings; CMD Proc; EVA Hardware Integration; Contractor Process Insight	Ronald B. Lee 3/7/02 For Ray Dell-Oss DX/Chief, EVA, Robotics, & Crew Systems Operations Division
FAC-MCC; FAC-Network Interface; FAC-IPS; Crit Processors/Applications; Non-Crit Processors/Applications; ODF/SODF Fabrication; Flight Anomaly Res; Anomaly-Proc; Ex/AI from Prior Reviews; No Constraints; Program Actions; Mission Requirements; Exception Resolution; CMD Proc	 Associate Program Manager, Flight Operations, SFOC
NETWORK; Flight Anomaly Resolution; Anomaly-Proc; Ex/AI from Prior Reviews; No Constraints; Program Actions	 Network Director, SSP-15SP, GSFC 3/4/02
	 Mission Operations Director 3/7/02

STS-110/8A FLIGHT READINESS STATEMENT



THE MISSION OPERATIONS FLIGHT PREPARATION PROCESS PLAN DOCUMENTED IN NSTS 08117, REQUIREMENTS AND PROCEDURES FOR CERTIFICATION OF FLIGHT READINESS, HAVE BEEN SATISFIED. REQUIRED PRODUCTS AND OTHER RESPONSIBILITIES FOR MISSION OPERATIONS (NSTS 08117, SECTION 8, PARAGRAPH 8.5.7) HAVE BEEN OR WILL BE PRODUCED OR COMPLETED. ALL AREAS ARE READY. MISSION OPERATIONS IS PREPARED TO SIGN THE CERTIFICATE OF FLIGHT READINESS FOR STS-110/8A.

J.M. Heflin
MISSION OPERATIONS DIRECTOR

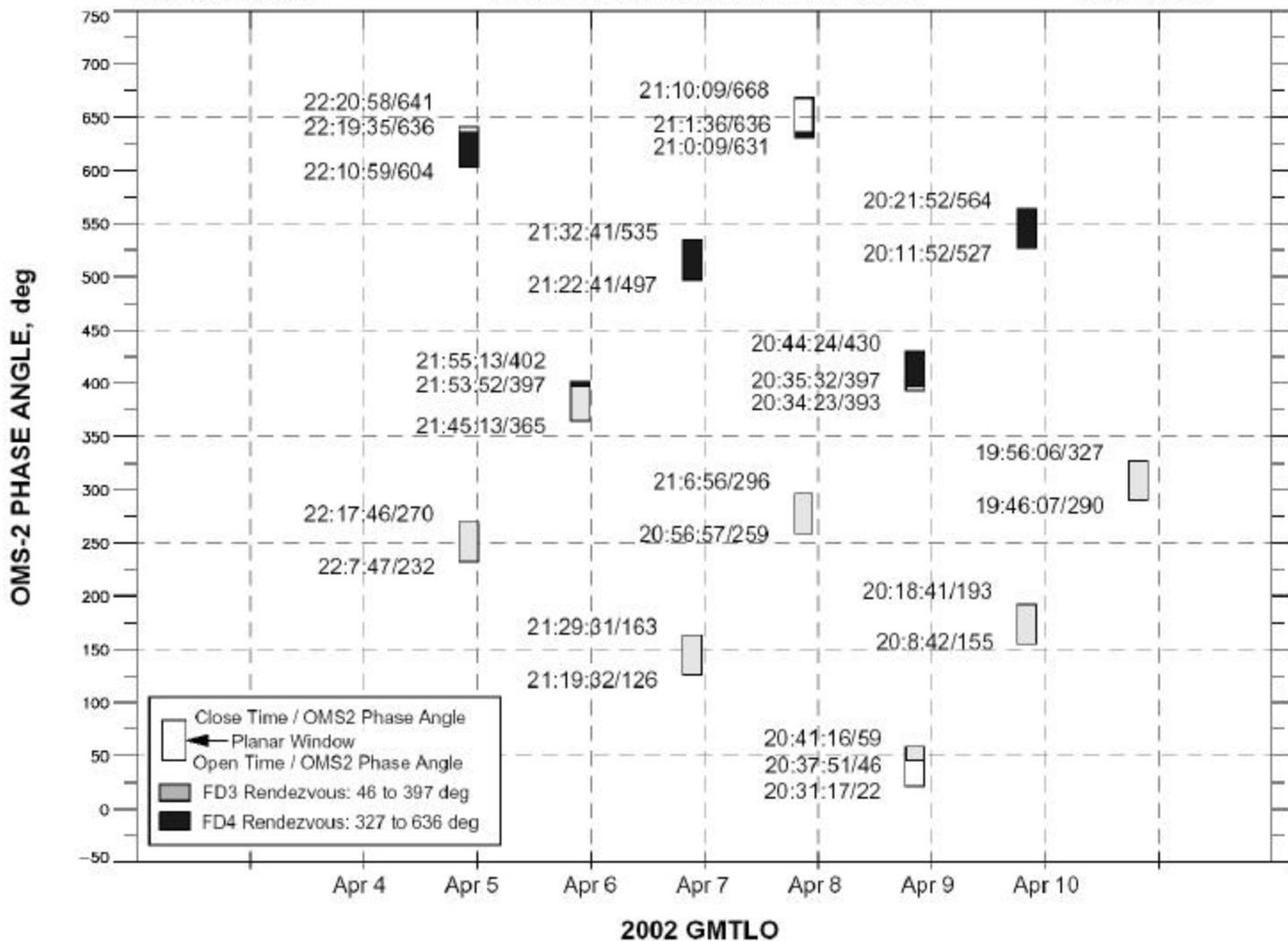
C. L. VERMILYEA
VICE PRESIDENT AND ASSOCIATE
PROGRAM MANAGER, FLIGHT
OPERATIONS, SPACE FLIGHT OPERATIONS
CONTRACT

BACKUP CHARTS

ISS State Vector
 source: TOPO
 received: 3/11/02
 ha/hp: 212 x 205 nmi

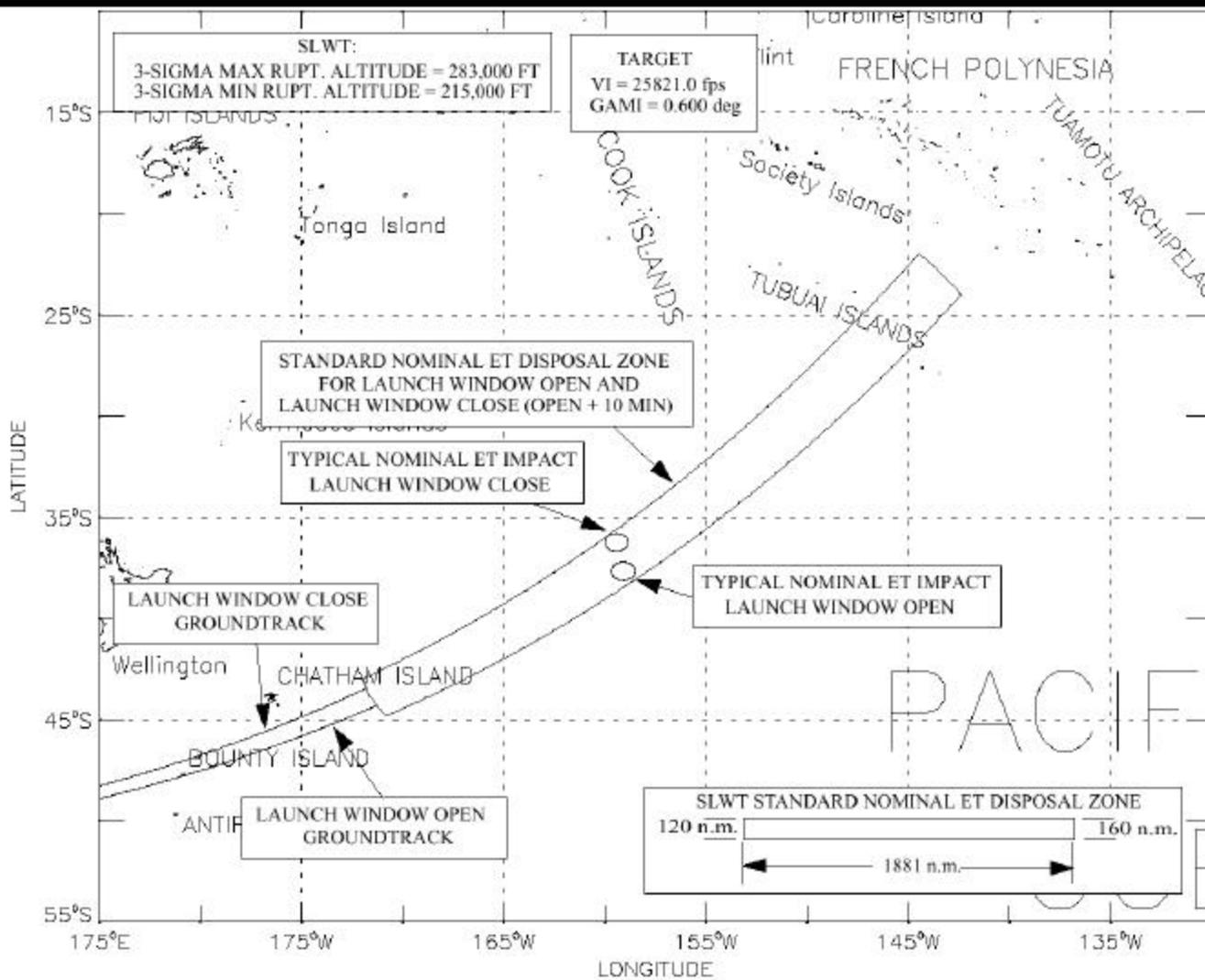
STS-110 FRR DAILY PLANAR/PHASE WINDOWS

N. Wortham/USH-483L
 T. Nguyen/USH-483L
 March 14, 2002



Nominal ET Impact Area

STS-110



FLIGHT DESIGN AND DYNAMICS
D48400 - 3/07/02

FDD BU-11

STS-110/8A FRR/MOD